Combining remote sensing and in situ observations to study the physical-biological coupling at fine scale: recent Mediterranean campaigns and outlook

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The oceanic fine scales are highly energetic features (eddies, fronts, meanders, filaments) with relatively short lifetimes (days/weeks to months). Due to their associated strong gradients in physical and biogeochemical properties, they crucially affect ocean physics and ecology with potential impacts at the climate scale. The temporal scale associated with these horizontal and vertical fine scales is the same as many important ecological processes including phytoplankton growth and competition. This temporal resonance is one of the reasons behind the fine-scale variability appearing in the marine ecosystems structure and related domains, including biogeochemical cycles, trophic food-webs up to resources and biodiversity.

Over the past few decades, great progresses have been made in characterizing fine scales through modeling. Remote sensing is also improving rapidly in terms of resolution, with landmark missions like SWOT expected to be operational very soon (2022). However, in situ sampling remains challenging due to the difficulties of mapping a large domain covering the length of a filament or the diameter of an eddy (~100km) at high spatio-temporal frequency (~km and ~daily).

Here we present some sampling strategies we are developing for addressing this issue by combining remote sensing and in situ multi-platform high-resolution sampling of physical, biogeochemical and biological variables.

In a series of campaigns in the Mediterranean Sea (OSCAHR 2015, PROTEVSMED-SWOT 2018, FUMSECK 2019), satellite-based adaptive and Lagrangian strategies proved to be successful to target and follow fine scale structures in situ. When paired with in situ biological measurements, like automated cytometry, these strategies highlight the important role of the fine scales in structuring the phytoplankton community by acting as fluid dynamical barriers and biodiversity hot-spots.

To extend these observations to other regions, we support an international coordinated experimental effort of the fine scale community at several sites all around the world to fully exploit the great opportunities offered by the launch of the satellite SWOT.

How to cite: Doglioli, A. M., Grégori, G., d'Ovidio, F., Petrenko, A. A., Barrillon, S., Fuda, J.-L., Thyssen, M., Tzortzis, R., Izard, L., Dumas, F., Garreau, P., Pascual, A., Marrec, P., Rousselet, L., Bhairy, N., Cyr, F., Tedetti, M., Berline, L., and Carlotti, F.: Combining remote sensing and in situ observations to study the physical-biological coupling at fine scale: recent Mediterranean campaigns and outlook., EGU General Assembly 2020, Online, 4–8 May 2020, EGU2020-7356, https://doi.org/10.5194/egusphere-egu2020-7356, 2020